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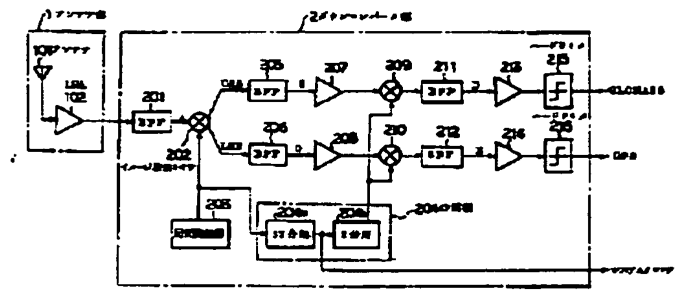
TITLE : RECEIVER COMMON TO GPS AND GLONASS



ABSTRACT : PURPOSE: To realize frequency-conversion of an RF (high frequency) signal into an IF (intermediate frequency) signal without using a plurality of mixers.

CONSTITUTION: RF GPS (Global Positioning System) and GLONASS (Global orbiting Navigation Satellite System) signals which are received by an antenna part 1 and high-frequency-amplified are converted into first IF signals by an image removing mixer 202. The oscillation frequency of a local oscillator 203 is set to be at the middle between the GPS carrier frequency and GLONASS carrier frequency. The mixer 202 separates the GPS signlas and GLONASS signals related to imaging against the local oscillation frequency while frequency-converting.

Figures.

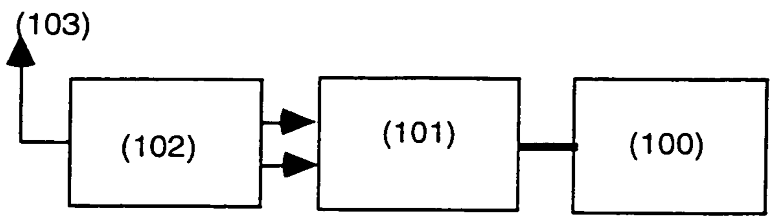


Figure 1

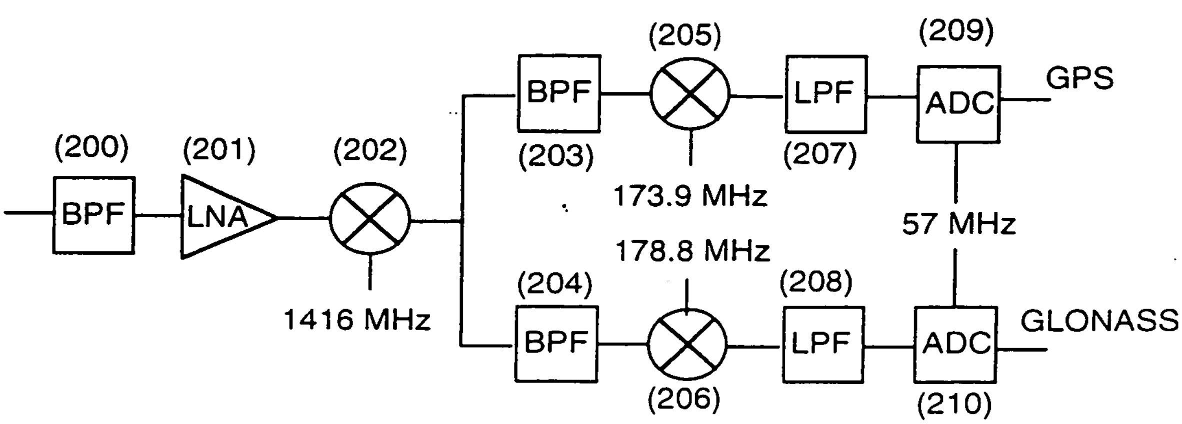


Figure 2:

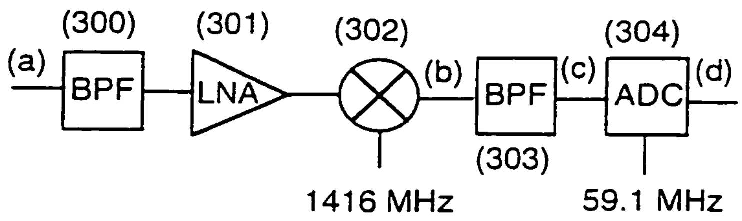


Figure 3

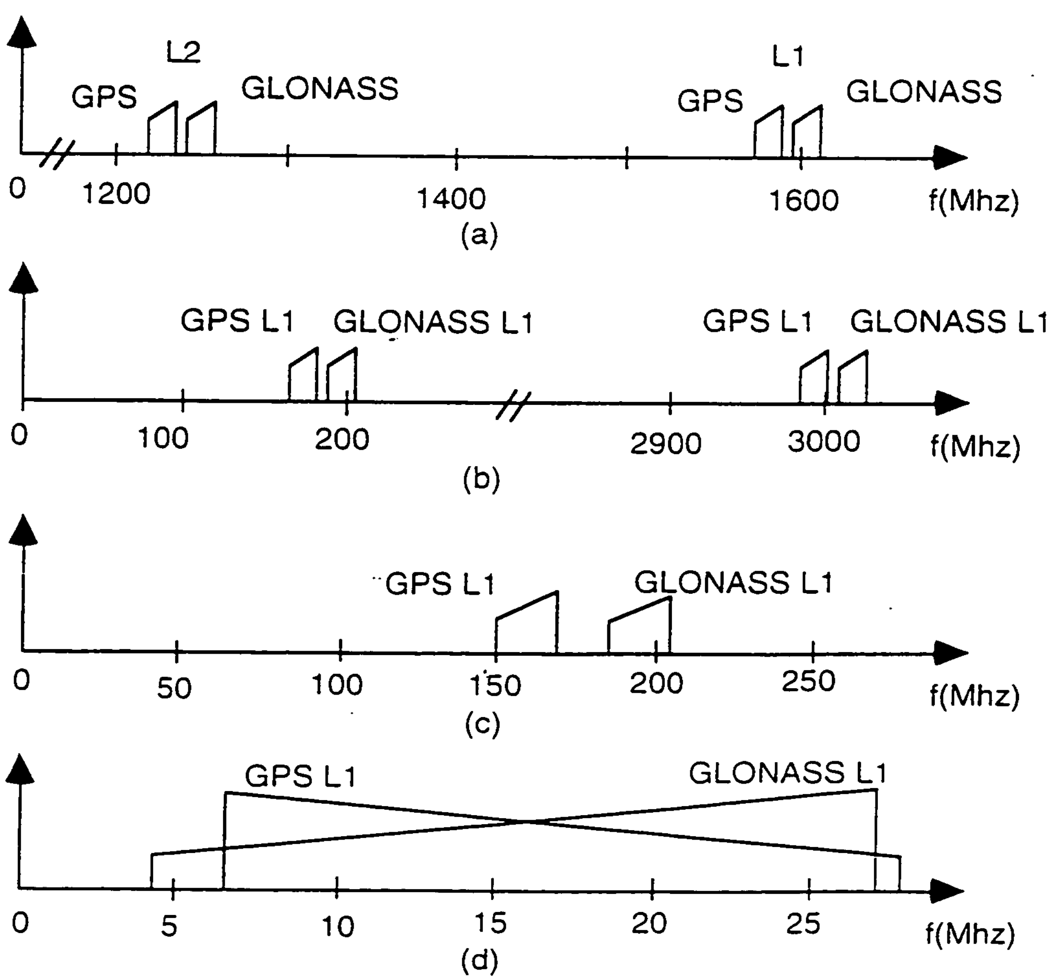


Figure 4

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Patent examination claim	Not yet claimed	9 items claimed OL (in total 9 pages)

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(54) Title of the invention
Receiver common to GPS/GLONASS

(57) Summary

(purpose)
To realize frequency-conversion of RF (high frequency) signals into IF (intermediate frequency) signals without using a plurality of mixers.

(composition)
RF GPS (Global Positioning System) and GLONASS (Global Orbiting Navigation Satellite System) signals which are received by an antenna-part 1 and are high-frequency amplified, are converted into first IF signals by an image removing mixer 202. The oscillation frequency of a local oscillator 203 is set to be at the middle between the GPS carrier frequency and the GLONASS carrier frequency. The image-removing mixer 202, while performing frequency-conversion, separates the GPS and GLONASS signals which are in a mutual imaging relation against the local oscillation frequency.

(scope of the claimed patent)
(claimed item 1)
A method for frequency-conversion with the characteristics that
a local oscillation signal is emitted with a frequency which is set in such a manner that a first carrier frequency, which is used at the moment when in a first measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, and a second carrier frequency, which is different from the first carrier frequency and is used at the moment when in a second measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, are in a mutual imaging relation, or with 1/nth (n: an integer equal to or more than 2) of this frequency,;
the received signal which consists of the measuring signals related to each measuring system as frequency components, is mixed with the emitted local oscillation signal or its nth order high-frequency, by means of a mixing device;
from the mixed signals, the components which are in an imaging relation seen from the frequency of the local oscillation signal or from its nth order high frequency, are separated and outputted;
whereby the measuring signals related to a plurality of measuring systems are frequency-converted by means of a simple mixing device, and moreover, interference between the measuring signals related to each measuring system is removed.

(claimed item 2)
A frequency-conversion electric circuit which provides the means to send a local oscillation signal with a frequency set in such a manner

that a first carrier frequency, which is used at the moment when in a first measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, and a second carrier frequency, which is different from the first carrier frequency and is used at the moment when in a second measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, are in a mutual imaging relation, or with 1/nth of this frequency (n: an integer equal to or larger than 2);
and which provides a mixing device to mix the received signal which includes the measuring signals related to each of the measuring systems as frequency components, with the emitted local oscillation signal or its nth order high frequency, and which separates and emits from the mixed signals, the components which are in an imaging relation seen from the frequency of the local oscillation signal or from its nth order high frequency;
and which has the characteristic that the measuring signals related to a plurality of measuring systems are frequency-converted by means of a simple mixer, and moreover, interference between the measuring signals related to each measuring system is eliminated.

(claimed item 3)
A receiver common to a plurality of measuring systems, which has the characteristic that it provides the means to receive signals which include the measuring signals emitted from measuring satellites which constitute each measuring system, as frequency components;
and the frequency-conversion electric circuit mentioned under claimed item 2.

(claimed item 4)
The receiver common to a plurality of measuring systems, mentioned under claimed item 3, which provides recovering devices to recover the measuring signals which have been separated from each measuring system upon converting each of them to a base band;
and which provides a device which chooses the appropriate satellite for measuring calculations amongst the measuring satellites related to the received measuring signals;
and which finds the position of a loaded moving body or of a carrying user, by performing the said measuring calculations based on the recovered measuring signals related to the chosen satellites;
and which has the characteristic of performing measuring calculations by the combined use of the measuring satellites of each of the measuring systems, when deemed necessary.

(claimed item 5)
The receiver common to a plurality of measuring systems, mentioned under claimed item 4, which establishes a number of the above-mentioned recovering devices according to the largest number of

satellites;
and, which has the characteristics of allocating a number of recovering devices related to the satellites used for measuring calculations, when performing the conversion and recovery of the measuring signals separated from each measuring system, to the baseband;
and of cutting off the electricity supply to the recovering devices that are not allocated to a satellite.

(claimed item 6)
The methods, electric circuits and devices mentioned under claimed items 1 to 5, which have the characteristics that
the frequency of the local oscillation signal is a frequency set in such a manner that a first carrier frequency 1 and a second carrier frequency 2 are in an imaging relation with each other;
and that the mixing device directly mixes the local oscillation signal with the received signal.

(claimed item 7)
The methods, electric circuits and devices mentioned under claimed items 1 to 5, which have the characteristics that
the frequency of the local oscillation signal is 1/nth of a frequency set in such a manner that a first carrier frequency 1 and a second carrier frequency 2 are in an imaging relation with each other;
and that the mixing device mixes an nth order high frequency of the local oscillation signal with the received signal.

(claimed item 8)
The methods, electric circuits and devices mentioned under claimed items 1 to 7, which have the characteristic that the first measuring system is GPS, whereby the carrier frequencies of each of the plurality of measuring satellites are the same.

(claimed item 9)
The methods, electric circuits and devices mentioned under claimed items 1 to 8, which have the characteristic that the second measuring system is GLONASS, whereby the carrier frequencies of each of the plurality of measuring satellites generally differ.

(detailed explanation of the invention)
(0001)
(the scope of the utilization in industry)
This invention is related to receivers which can be commonly used for a plurality of measuring systems, which make use of measuring satellites, e.g. the GPS (Global Positioning System) developed and employed in the United States, or GLONASS (Global Orbiting

Navigation Satellite System) developed and employed in Rúsia; for example receivers common to GPS/GLONASS; and is especially related to the methods and electric circuit used in frequency-conversion of high frequency (RF) signals into middle frequency (IF) signals in this sort of receiver.

(0002)
(the former technique)
As for systems which track down the position or speed of moving objects etc., in other words measuring systems, a number of system types is known; however systems which have drawn attention in recent years and which have come into use very fastly, are systems such as GPS or GLONASS, whereby the position of moving bodies on which the receiver is loaded, or users who are carrying the said receiver, is tracked down, based on signals emitted from measuring satellites.

(0003)
For example with regard to GPS and GLONASS, only the carrier frequency from the measuring satellites and the code-setting of false noise (Pseudo Noise: PS) etc. are differt from each other, and generally speaking, the principles for measuring and the measuring calculations are the same principles and calculations. Therefore, receivers that can be commonly used for these measuring systems, can certainly be realized, and in fact, the development of this type of receiver is being actively persued.

(0004)
(the problem areas this invention tries to solve)
However, the carrier frequency of the measuring signals from the measuring satellites which constitute GPS (hereafter referred to as GPS satellites and GPS signals) and the carrier frequency of the measuring signals from the measuring satellites which constitute GLONASS (hereafter referred to as GLONASS satellites and GLONASS signals) are different from each other. To put it concretely, the carrier frequency of the GPS satellites is 1575.42 MHz, while the carrier frequency of the GLONASS satellites (according to approximations mentioned hereafter) is 1602.5625 MHz - 1608.75 MHz; thus they are frequencies which both belong to the L-band, but which are different from each other.

(0005)
Thus, when constructing a receiver which can be commonly used for a plurality of measuring systems, in the case when the carrier frequencies of the signals from the measuring satellites are different from each other, individual and separate mixers and local oscillators are necessary to perform frequency-conversion from RF to IF. This

increases the number of parts which constitute the receiver, and forms an obstacle to miniaturization and lowering of costs.

(0006)

(the problem areas this invention tries to solve)

This invention has been completed in order to solve this sort of problem areas. It realizes frequency-conversion of RF into IF with the use of one single mixing device (a mixer etc.); and hereby this invention's first aim is a decrease in the number of parts which constitute the receiving device, and in its turn the miniaturization and the lowering of the cost of the receiving device. Furthermore, this invention's second aim is that the IF related to each measuring system does not cause any interference at the moment of frequency-conversion. Furthermore, this invention's third aim is to perform measurements by the combined use of measuring satellites which constitute a plurality of measuring systems. This invention's fourth aim is to lower the electric power consumption of the receiving device. Finally, this invention's fifth aim is to diminish the local oscillation frequency.

(0007)

(the means to solve the problem areas)

In order to reach the above-mentioned aims, the method of this invention has the characteristics that

a local oscillation signal is emitted with a frequency which is set in such a manner that a first carrier frequency, which is used at the moment when in a first measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, and a second carrier frequency, which is different from the first carrier frequency and is used at the moment when in a second measuring system a measuring signal is emitted from a measuring satellite in orbit around the earth, are in a mutual imaging relation, or with 1/nth (n : an integer equal to or more than 2) of this frequency,;

the received signal which consists of the measuring signals related to each measuring system as frequency components, is mixed with the emitted local oscillation signal or its nth order high-frequency, by means of a mixing device;

from the mixed signals, the components which are in an imaging relation seen from the frequency of the local oscillation signal or from its nth order high frequency, are separated and outputted;

whereby the measuring signals which are related to a plurality of measuring systems are frequency-converted by means of a simple mixing device, and moreover, interference between the measuring signals related to each measuring system is eliminated.

(0008)
Furthermore, the frequency-conversion electric circuit of this invention has the characteristics that it provides the means to send a local oscillation signal with a frequency set in such a manner that the above-mentioned first carrier frequency and the above-mentioned second carrier frequency, are in a mutual imaging relation, or with 1/nth of this frequency (n is an integer equal to or larger than 2);
and which provides the mixing device to mix the received signal which includes the measuring signals related to each of the measuring systems as frequency components, with the emitted local oscillation signal or its nth order high frequency, and which separates and emits from the mixed signal, the components which are in an imaging relation seen from the frequency of the local oscillation signal or from its nth order high frequency;
and which has the characteristic that the measuring signals which are related to a plurality of measuring systems are frequency-converted by means of a simple mixing device, and moreover, interference between the measuring signals related to each measuring system is eliminated.

(0009)
The receiver of this invention which is common to a plurality of measuring systems, has the characteristic that it provides:
the means to receive the signals which include the measuring signals emitted from measuring satellites which constitute each measuring system, as frequency components;
and the frequency conversion electric circuit of this invention.

(0010)
The receiver of this invention which is common to a plurality of measuring systems, furthermore has the characteristic that it provides a recovering device to recover the measuring signals which have been separated from each measuring system upon converting each of them to a base band;
and that it provides a device which chooses the appropriate satellite for measuring calculation amongst the measuring satellites related to the emission of the received measuring signals;
and that it finds the position of a loaded moving body or of a carrying user, by performing the said measuring calculation based on the recovered measuring signals related to the chosen satellites;
and which has the characteristic that, in case of necessity, it performs measuring calculations by the combined use of the measuring satellites of each of the measuring systems .

(0011)
The receiver of this invention which is common to a plurality of measuring systems, has the characteristics of individually establishing

the above-mentioned recovering devices according to the largest number of satellites used for the measuring calculations;
and of allocating a number of recovering devices to the satellites used for measuring calculations, when performing the conversion and recovery of the measuring signals separated from each measuring system, to the baseband;
and of cutting off the electricity supply to the recovering devices that are not allocated to a satellite.

(0012)
The methods, electric circuits and devices of this invention, have the characteristics that, as condition number 1,
the frequency of the local oscillation signal is a frequency set in such a manner that a first carrier frequency 1 and a second carrier frequency 2 are in an imaging relation with each other;
and that the mixing device directly mixes the local oscillation signal with the received signal.

(0013)
The methods, electric circuits and devices of this invention, have the characteristics that, as a condition number 2,
the frequency of the local oscillation signal is 1/nth of a frequency set in such a manner that a first carrier frequency 1 and a second carrier frequency 2 are in an imaging relation with each other;
and that the mixing device mixes an nth order high frequency of the local oscillation signal with the received signal.

(0014)
Finally, the methods, electric circuits and devices of this invention, which have the characteristic that the first measuring system is GPS, whereby the carrier frequencies of each of the plurality of measuring satellites are the same;
and the second measuring system is GLONASS, whereby the carrier frequencies of each of the plurality of measuring satellites generally differ.

(0015)
(the use)
In this invention the frequency of a local oscillation signal is set in such a way that a first carrier frequency and a second carrier frequency are in a mutual imaging relation with each other (in other words a frequency which is approximately the middle between the first and the second carrier frequency), or it is set at 1/nth of this frequency.The measuring signal, which is emitted by the measuring satellites related to each of the measuring systems with the first or with the second frequency, and wich is received by a receiving device (the received signal), is frequency-converted by means of a mixing

device, from RF into for example IF. At that moment, as mentioned above, because the local oscillation signal's frequency has been fixed, each of the components of the received signal (in other words the frequency components appropriate to the measuring satellites of each of the measuring systems) are in a mutual imaging relation to each other, seen from the local oscillation signal or it's nth high frequency. In this invention, when this kind of local oscillation signal or it's nth high frequency is mixed with the received signal, and converted into for instance IF, a construction which mutually separates the imaging signals, in other words an imaging (image-) removing mixer etc. is used as mixing device. In this way, the measuring signals related to the plurality of measuring systems are frequency-converted, by means of one simple mixing device, and moreover, interference between the measuring signals related to each of the measuring systems, is eliminated. Consequently, in order to perform frequency-conversion from RF into for instance IF, simplification of the circuit formation, decrease of the number of circuit parts, miniaturization and lowering of the costs of the receiving device etc., can be realized smoothly without hindering the frequency-conversion process into IF or lower frequencies.

(0016)
As to the structure of the mixing device which brings about this kind of usage, first of all there is a construction related to fundamental-mixing. In this case, the frequency of the local oscillation signal is set in such a way that the first carrier frequency and the second carrier frequency are in a mutual imaging relation with each other. The mixing device directly mixes the received signal and the local oscillation signal. By making use of this kind of construction, the above-mentioned use can be realized, by means of a relatively simply constructed mixing device.

(0017)
Furthermore, as another construction of a mixing device, there is a construction related to high frequency (harmonic) mixing. In this case, the frequency of the local oscillation signal is set to be 1/nth of the frequency whereby the first carrier frequency and the second carrier frequency are in a mutual imaging relation with each other. The mixing device directly mixes the received signal with the nth high frequency of the local oscillation signal. By making use of this kind of construction, the above-mentioned use is realized and in comparison with fundamental-mixing, it brings forth advantages such as a decrease of the frequency of the local oscilation signal, and as a result, simplification of the circuit formation of the local oscillator, reduction of energy consumption etc..

(0018)

Moreover, in this invention, not only is the above-mentioned usage realized, it is also possible to perform measuring calculations making combined use of the measuring satellites of each of the measuring systems, if it is deemed necessary. This is to say that measuring signals which have been separated from each of the measuring systems, are converted to a base-band and recovered, and furthermore, the satellites most appropriate for measuring calculations are chosen, and based on the measuring signals of the thus chosen satellites (the recovered signals), the said measuring calculations are performed. By means of these measuring calculations, the exact position of loaded moving objects or carrying users can be traced, by making combined use of each measuring system. For example, in the case where one applies this kind of construction to measuring systems such as GPS and GLONASS, which on completion time, each will make use of 24 measuring satellites, it will become possible to choose from a total of 48 measuring satellites the ones with the highest measuring accuracy, assort them, and use them for measuring calculations.This is effective in continually maintaining a high measuring accuracy.

(0019)

As to the above-mentioned recovering devices, it is preferable to fix their number according to the largest number of satellites which are used for measuring calculations. In this case, the supply of electric power to the recovering devices that are not used is cut off, and thereby a decrease in the consumption of electric energy of the receiving devices can be realized.

(0020)

As to the appropriate measuring systems , GPS and GLONASS can be put forth. In GPS the carrier frequency of each measuring satellite is the same; in GLONASS the carrier frequencies of each of the satellites generally differ. As to the combined use of such systems, our invention could be applied, by treating the measuring signals from each measuring system, as respectively the USB (Upper Side Band) and the LSP (Lower Side Band) of the received signal. In other words, it is necessary that the above-mentioned first and second carrier frequencies, are characteristic to each of the measuring systems, and moreover that they differ from one another, but it is not necessary that they respectively have one simple frequency. Furthermore, it is possible to apply this invention to other measuring systems, apart from GPS or GLONASS.

(0021)

(Operation example)

Below an explanation of an ideal operation example of this invention is given, based on drawings.

(0022)
In drawing 1 and drawing 2 a concrete example of the construction of the receiving device of this invention is shown. This device is built up of an antenna part 1, a down converter part 2, and a signal processing part 3.

(0023)
This receiving device is a receiving device which can be commonly applied to GPS and to GLONASS. This is to say: it is a receiving device which can make use both of GPS signals emitted by GPS satellites, and of GLONASS signals emitted by GLONASS satellites, for measuring calculations. In the GPS system, at the time of completion, there will be 24 artificial satellites (GPS satellites) set off at 6 orbit surfaces with an altitude of about 20.000 km. As to the GLONASS satellites, they have the same number (24) and altitude (about 20.000 km) as the GPS satellites, but the orbit surfaces amount to 3.

(0024)
In both GPS and GLONASS when emitting a signal from a satellite, a fixed PN code is used, and the said signal undergoes spectrum diffraction modulation. The receiving device which receives the signal from the satellite, frequency-converts the received signal from RF into IF, and from IF onto the baseband; moreover, the PN code which is used for the carrier and spectrum diffraction modulation from the satellite, is seized, and the signal is recovered. The receiving device uses the recovered signals etc., and tracks down the distance to the satellite (however this is called the false distance, as it contains ofsets) and the position of the satellite. In case this kind of information is obtained regarding a fixed number of satellites (in the case of third order measurements, 4; in the case of second order measurements, 3)the position of the receiving device, this is to say, the position of loaded moving bodies or carrying users, can be tracked down, by means of simultaneous equations calculations.

(0025)
The most important differences between the GPS signals emitted by GPS satellites, and GLONASS signals emitted by GLONASS satellites, consist in the first place of a difference in carrier frequency (the frequency of the carrier) and in the second place a difference in PN code.

(0026)
First of all, the carrier frequency of the GPS satellites, no matter which GPS satellite, belongs to the L-band and is 1575.42 Mhz; the spectrum of the GPS signals increases to a frequency vicinity of about 2 MHz, by means of tip rate 1.023 MHz spectrum diffraction modulation. The PN code of the GPS system, is characteristic to each GPS satellite.

At the side of the GPS receiving device, the PN codes of the satellites are generated, are used for spectrum reverse diffraction, and the signal is recovered.

(0027)
On the other hand, the carrier frequencies of the GLONASS satellites belong to the L-band and are 1602.5625 MHz - 1608.75 MHz, and each carrier frequency of each separate satellite is different. However, because an identical carrier frequency is allocated to the GLONASS satellites which are on opposite sides seen from the earth, 12 frequencies (channels) are used in the emission of signals from the satellites, belonging to the 1602.5625 - 1608.75 MHz band zone. As to the GLONASS PN codes, they are identical for all of the GLONASS satellites. The tip rate of GLONASS is 0.511 MHz, and the width of the band of GLONASS signals which have been spectrum-diffracted, is about 1 MHz. At the side of the GLONASS receiving device, the frequencies related to the satellites are generated, and using these, the carrier is seized, and spectrum reverse diffraction is performed, with the use of the PN code common to each of the satellites.

(0028)
The above-mentioned GLONASS method is the method which is applied in the situation in which the discovery was realized, at the time of the patent application of this invention. This is to say, regarding the GLONASS method, problems of interference with other systems occur, and the allocation of the carrier frequencies of the GLONASS signals is not confirmed. However, the main point of this invention is that we assume that, in the above-mentioned sense, and according to the following explanation, the discovery has been confirmed, because our main point does not rely on the details of the results of the discovery.

(0029)
In drawing number 1, antenna part 1 is composed of an antenna 101 and a Low Noise Amplifier (hereafter referred to as LNA) 102. The antenna 101 receives GPS and GLONASS signals which are emitted from GPS and GLONASS satellites. LNA 102 low-noise-amplifies the signals received from the antenna 101. The amplified received signals are introduced to a down converter part 2.

(0030)
The received signals which have been introduced to the down converter part 2, are band-filtered through a Band Pass Filter (hereafter referred to as BPF). This BPF 201 is for example composed of an induced electricity resonator, and the width of its transitband should enable both GPS and GLONASS signals to pass, and is set at a band range of 1575.42 MHz - 1608.75 MHz. The distribution of the

and 206, in other words the spectrum of points B and C of drawing number 1, becomes a spectrum such as shown in drawing number 4.

(0037)

At the latter part of BPF 205 and 206, amplifiers 207 and 208 are installed. The amplifiers 207 and 208 respectively amplify the outputs of BPF 205 and 206. The mixers at their latter parts, mixers 209 and 210, respectively frequency-convert the outputs of amplifiers 207 and 208 from the first IF frequency into a second IF frequency. The local oscillation signal used in mixers 209 and 210 is the signal whereby the output of local oscillator 203 is 104 - cycled by means of cycler 204; and its frequency is 1595.43 MHz/104 = 13.995 MHz. Consequently, the second IF signal frequency which is obtained from mixers 209 and 210 becomes 0.675 MHz - 6.8625 MHz with regard to GLONASS, and 6.015 MHz with regard to GPS. At the latter part of mixer 209, BPF 211 is installed whose passage band is 0.675 MHz - 6.8625 MHz; and at the latter part of mixer 210, BPF 212 is installed whose middle frequency is 6.015 MHz, and whose passage band width is about 2 MHz. As to the signal spectrum after the unnecessary signals have been removed by means of BPF 211 and 212, in other words the spectrum of points D and E, this is shown in drawing number 4.

(0038)

Furthermore, the cycler 204 performs the 104 - cycling process by means of 57 - cycler 204a and 2 - cycler 204b, and the 1595.43 MHz/57=27.99 MHz frequency signal , outputted from 57-cycler 204a, is supplied to signal processing part 3, as a system clock.

(0039)

At the latter part of BPF 211 and 212, amplifiers 213 and 214 are installed. These amplifiers 213 and 214 respectively amplify the second IF frequency signals of GLONASS or GPS. Hard limiters 215 and 216 which are installed at their latter part, 1 bit-quantum- process the amplified second IF signals, and supply them to signal processor part 3.

(0040)

Signal processor part 3 is composed of a switch 301, a plural signal processor (in the drawing it are 5 signals) 307, and a calculator 306. Switch 301 selectively supplies GLONASS signals, which are second IF signals, and GPS signals, to a plurality of signal processors 307, according to the instructions of calculator 306.

(0041)

Each signal processor 307 is composed of mixers 302 and 303, a carrier generator 304, and a code generator 305. The carrier generator 304, works simultaneous with the system clock which is

provided from down converter part 2, and moreover, oscillates with a frequency which is set according to calculator 306. The frequency which is set according to calculator 306, is applied to the carrier frequencies related to the signals which need to be processed by this signal processor. The oscillation output of carrier generator 304 is mixed with the GLONASS or GPS signals which are supplied by the switch, by means of mixer 302. The output of mixer 302, in other words the base band signal, is supplied to calculator 306, via mixer 303. In other words, the calculator 306, the carrier generator 304 and the mixer 302 form a catch-loop to catch the carrier frequencies of the GLONASS or GPS signals.

(0042)
The output of mixer 302 is mixed with the output of code generator 305, in mixer 303. The code generator 305, simultaneous with the system clock supplied from down convertor part 2, generates the PN code which is fixed by means of calculator 306. As was mentioned above, because of the spectrum diffraction modulation of the GLONASS and GPS signals through the PN code, one can generate the PN code simultaneous with the emission time, by means of the code generator 305, and by mixing this with the GLONASS signal, which is a base band signal, or with the GPS signal, one can perform reverse spectrum diffraction of the said signals. In other words, the calculator 306, the code generator 305 and the mixer 303 form a catch-loop to catch the PN codes of the GLONASS or GPS signals, and the code generation loop of the code generator 305 is provided for the calculation of the false distance.

(0043)
Furthermore, as mixers 302 and 303, one may use exclusive logic elements (EXOR).

(0044)
The calculator 306 performs measurement calculations based on the control of switch 301, the control of the carrier and code generator in each signal processor 307, the output signals (recovered signals) of mixer 303 etc., and the electricity control etc. of each signal processor 307. In other words, the calculator 306 decides upon the group of satellites which are appropriate for the measurement calculations, from among the satellites that can be received at the moment, based on the recovered signals etc.. The calculator 306 controls switch 301, in order to supply the received signals which have been received from the satellites which form the group of chosen satellites, to signal processors 307. Signal processors 307 therefore are installed in a number higher than the number of satellites used for the process. Calculator 306 fixes the second carrier frequency which is applied to the carrier frequency of the satellites to

be received, to carrier generator 304 of each of the signal processors 307, and moreover fixes the PN code that is to be applied to code generator 305. The recovered signals which have been obtained by means of this control, especially the navigation messages included herein, together with the code generation loop of code generator 305 which displays the signal emission time of the satellites, are used for measurement calculations in calculator 306. Furthermore, the calculator 306 cuts the electricity of the signal processors 307 which are not used for the processing of the received signals, and thereby controls the electricity consumption.

(0045)
Consequently, according to this invention, because the oscillation frequency of local oscillator 203 is set in such a manner that the GLONASS signal's carrier frequency and the GPS signal's carrier frequency, are in a mutual imaging relation, by performing frequency-conversion of RF into a first IF through image-removing mixer 202 wich makes use of this oscillation signal, one can frequency-convert RF into first IF while separating GLONASS signals from GPS signals without interference, with the use of only one simple mixer 202. Hereby, simplification of the circuit construction used to perform the frequency-conversion of RF into first IF, decrease of the number of circuit parts, miniaturization and lowering of costs of the receiving device etc. can be achieved without causing any hindrance to the processing of frequencies equal to or lower than IF.

(0046)
Furthermore, because a construction is used related to fundamental mixing, as image-removing mixer 202, one can achieve the above-mentioned advantages by means of a relatively simplified mixer 202. Furthermore, in the case a construction is used related to harmonic mixing, the oscillating frequency of local oscillator 203, compared to the case of fundamental mixing, is lowered in inverse proportion to the degree of the high frequency. Consequently, advantages such as simplification of the circuit construction of local oscillator 203, decrease in the consumption of electricity, lowering of the cycles of cycler 204 etc. can be achieved.

(0047)
Furthermore, because the calculator 306 can perform measuring calculations by using both GLONASS and GPS satellites, a generally high measuring accuracy can be maintained. Moreover, the electricity consumption of the receiving device can be decreased, by cutting the electricity supply to those signal processors 307 which are not being used.

(0048)
Furthermore, the measuring systems which form the object of this invention's application, are not limited to GPS and GLONASS.

(0049)
(the effects of this invention)
As mentioned above,according to this invention, by making use of a construction of an imaging (image)-removing mixing device etc.as a mixing device related to frequency-conversion of RF into for example IF, which sets a local oscillation signal's frequency at a frequency by which a first carrier frequency and a second carrier frequency are in a mutual imaging relation, or at 1/nth of this frequency, and which also mixes and separates local oscillation signals or their nth high frequency with and from received signals, one can frequency-convert measuring signals related to a plurality of measuring systems by means of one simple mixing device, and one can moreover eliminate all interference between the measuring signals related to the respective measuring sysems. Consequently, because of the frequency-conversion of RF into for instance IF, one can realize simplification of the circuit constructiona decrease in the number of circuit parts, miniaturization and lowering of costs of the receiving device etc., without causing any hindrance to the processing into frequencies equal to or lower than IF.

(0050)
Furthermore, according to this invention, by making use of a construction related to fundamental mixing as mixing device, the above-mentioned advantages can be achieved by means of a relatively simply constructed mixing device. On the other hand, by using a construction related to high frequency (harmonic) mixing, while obtaining the above-mentioned advantages, compared to the case of basic wave mixing, one can lower the frequency of the local oscillation signal, and obtain effects such as the simplification of the circuit construction of the local oscillator, a decrease in the consumption of electricity etc..

(0051)
Moreover, according to this invention, because it was decided to perform measuring calculations while making combined use of measuring satellites of each measuring system when it is deemed necessary, the number of satellites which form the object of the groupselection for measuring calculation increases, and thereby one can maintain a generally high measuring accuracy.

(0052)
Moreover, according to this invention, the consumption of electric energy of the receiving device can be decreased, by cutting off the

supply of electric energy to the recovering devices which are not being used.

(0053)
Moreover, according to this invention, which is not limited to GPS or GLONASS etc., one can achieve each of the above-mentioned effects for all kinds of measuring systems, by applying the invention to measuring systems in which similar problems can arise.

(simple explanation of the drawings)
(drawing number 1) This is a block drawing which shows one part of the construction of the device related to one operation example.
(drawing number 2) This is a block drawing which shows another part of the construction of the device related to this operation example.
(drawing number 3) This is a block drawing which shows one example of the construction of the image-removing mixer which is used in this operation example.
(drawing number 4) This is a spectrum distribution drawing to explain the actions undertaken in this operation example.
(drawing number 5) This is a block drawing which shows another example of the construction of the image-removing mixer used in this operation example.
(explanation of the signs)

1	Antenna part
2	Down converter part
3	Signal processing part
101	Antenna
202	Image-removing mixer
203	Local oscillator
301	Switch
306	Calculation processor
307	Signal processor

(drawing number 1)
Construction of operation example (1)

1	Antenna part *(top left)*
2	Down converter part *(top)*
215	Hard limiter
216	Hard limiter
202	Image-removing mixer
203	Local oscillator
204a	57 cycles
204b	2 cycles
204	Cycler

(between 204a and 204b) system block

(drawing number 2)

Construction of operation example (2)

3	Signal processing part *(top)*	
307	Signal processor	(5 ch minutes)
304	Carrier generator	
305	Code generator	
(between 307 and 306)		Recovered signals Electricity control PN code setting Carrier frequency setting
(between 301 and 306)		Switch control
306	Calculation processor	
(right)	measuring output	
(bottom in the direction of 306)		System block

(drawing number 3)

Construction of the image-removing mixer
202a RF Hybrid
202d IF Hybrid

(drawing number 5)

Image-removing harmonic mixer
202a RF Hybrid
202d IF Hybrid

(drawing number 4)

Actions of the operation example (spectrum)
RF signal
First IF signal (USB)
First IF signal (LSB)
Second IF signal (USB)
Second IF signal (LSB)

spectrum of the received signals, after passage through this BPF 201, in other words the signal spectrum of point A in drawing number 1, is shown in drawing number 4.

(0031)

Down converter part 2, furthermore an image-removing mixer 202, and a local oscillator 203 are provided. The local oscillator 203, indicated in drawing number 4 as LO, oscillates at 1595.43 MHz. The local oscillation signal which is obtained from this oscillation, is mixed with received signal A, by means of an image-removing mixer 202 which has a composition such as shown in drawing number 3.

(0032)

The image-removing mixer 202 which is shown in drawing number 3, has a construction related to fundamental mixing. This image-removing mixer 202 is composed of a RF Hybrid 202a, mixers 202b, and 202c and IF Hybrid 202d. The signal supplied from BPF 201, in other words the RF received signal A, is introduced into RF Hybrid 202a. One part of the output signal of RF Hybrid 202a is supplied to mixer 202b, the other part is supplied to mixer 202c. In the mixers 202b and 202c the local oscillation signals are mixed with the signals from RF Hybrid 202a. The two types of signals obtained as a result of the mixing are introduced into IF hybrid 202d. As to the composition of RF Hybrid 202a, a commonly known construction can be used. (For example: see Electronic Information Correspondance Symposium Publication "Microwave circuits used for communication", 1989, pp. 58-59). As to the composition of IF Hybrid 202d, because the frequency is low, a commonly known composition of a Concentrated Fixed Number Type can be used. (For example: see the drawing in"Blueprint for a Concentrated Fixed Number Type Direction Coupler", Ikeda, Kida, Television Symposium Magazine, 1976, volume 30, number 6, p.482).

(0033)

Here the frequency of the local oscillation signal is set in such a way that the carrier frequency 1575.42 MHz of the GPS signals and the carrier frequency 1575.42 MHz - 1608.75 MHz of the GLONASS signals, are in a mutual imaging (image) relation to each other, seen from the local oscillation signal frequency. In other words, the local oscillation signal frequency is set so as to establish a relation consisting of :
(local oscillation signal frequency) - (GPS signal carrier frequency) = (GLONASS signal carrier frequency) - (local oscillation signal frequency). Consequently, one of the two outputs from IF Hybrid 202d, seen from the local oscillation signal, is a GLONASS signal which is USB, and the other one is a GPS signal which is LSB. This means that in the case when the local oscillation signal is taken as the standard,

the two types of frequency components (GLONASS signals and GPS signals) are separated independently, while removing outside interference from each of them, by means of IF Hybrid 202a and 202d, in other words while removing the images. Furthermore, because of the frequency-conversion which takes place in each of the mixers 202b and 202c, the two outputs of IF Hybrid 202d respectively become IF signals (first IF signals). In the case of this operation example, this means for the first IF frequency of GLONASS signals emitted as USB from IF Hybrid 202d: (GLONASS carrier frequency) - (local oscillation signal frequency) = 7.1325 MHz - 13.32 MHz. In the case of the first IF frequency of GPS signals emitted as LSB from IF Hybrid 202d, this means: (local oscillation signal frequency) - (GPS carrier frequency) = 20.01MHz.

(0034)
Furthermore, as for the image-removing mixer 202, one may also use a construction for harmonic mixing, and disregard the above-mentioned construction related to fundamental mixing.

(0035)
In drawing number 5 one example of the construction of a second order (n=2) image-removing harmonic mixer is shown. In the case of this mixer 202, as RF Hybrid 202a a construction as described in the Electronic Information Communication Symposium's "Microwave Circuits used for Correspondance", page 59, drawing 2.23 (b) is desirable. This is because an octave wide band is required, whereby by means of the second order harmonic mixer, the local oscillation frequency becomes about 1/2 of the RF frequency, and they both become a passing zone. Furthermore, as IF Hybrid 202d, it is preferable to use a Concentrated Fixed Number Hybrid Circuit such as described in the Television Conference Magazine's Thesis, Drawing number 1. This is also because the low IF frequency, which has been mixed down by parallel junction pairs 202e and 202f of diodes which are connected in two groups to the output of RF Hybrid 202a, is inputted into IF Hybrid 202d; and because miniaturization is possible in the case of a Concentrated Fixed Number Type Hybrid Circuit. Furthermore, 202g and 202h in the drawing, are the LPF which low band-filters the output of the diode pairs 202e and 202f.

(0036)
The outputs of the USB and the LSB of the IF Hybrid 202d, are respectively band pass filtered through BPF 205 or 206. The passage band of each BPF 205 and 206, is set at the frequency band of each first IF signal, in other words for BPF 205 this is at the 7.1325 MHz - 13.32 MHz band; for BPF 206 this is middle frequency 20.01 MHz, and a band width of about 2 MHz. Consequently, the signal spectrum after the unnecessary signals have been removed by means of BPF 205